Student Electronics Technician (SET)
Basic Electronics Competency Requirements

For use by high school and post-secondary programs that offer training in basic electronic applications. The SET may be used for program assessment and as student certification from the following topics in these competencies.

1.0 Safety
1.1 Describe electrical shock and its causes
1.2 List the effects of electric current on the human body
1.3 Explain shock hazards when working around power sources
1.4 Identify sources of static charges and its damage to sensitive components
1.4.1 Describe static charge prevention straps, mats and grounding
1.5 List tools use hazards in the workplace and in the field
1.6 Describe lockout and tagging rules for unsafe electrical or mechanical hazards
1.7 Explain where eye and ear protection are needed
1.8 List safety concerns related to the National Electrical Code®
1.9 Describe the types and usage of fire extinguishers

2.0 Electron Theory
2.1 Describe atomic structure and parts of the atom with its electric charges
2.2 Describe the action of electrons, protons and neutrons
2.3 Explain static charges and coulombs
2.4 Explain current flow and units of measure
2.5 Explain potential difference, voltage drop and units of measure
2.6 List types of resistive materials and units
2.7 Describe voltage sources, batteries and electromagnetic force
2.8 Explain the creation of magnet poles and magnetic effects

3.0 DC Basics
3.1 State Ohm’s law and Watt’s power laws
3.2 List 12 common basic electronic formulas derived from Ohm’s and Watt’s laws
3.3 State Kirchhoff laws for current and voltage
3.4 Explain formulas used in series circuits
3.5 Explain formulas used for parallel circuits
3.6 Identify circuit configurations of series, parallel and combination circuits
3.7 Explain the purposes of grounding and common conventions
3.8 Calculate power consumption, dissipation and energy units
3.9 Describe capacitance and its units of measure including charging and discharging curves

4.0 AC Basics
4.1 List methods that produce alternating current
4.2 Describe sine wave shapes and RMS values
4.3 Describe capacitance and its units of measure
4.4 Describe magnetic flux and inductance and list its units of measure
4.5 Explain how series circuits with R, C and L values are used in electronics equipment
4.6 Explain how inductance relates to magnetism and describe coil construction, cores and usages
4.7 Compare reactance and resistance and describe current/voltage relationships
4.8 Compare impedance with reactance and resistance
4.8.1 Explain the causes and effects of impedance

5.0 Wire and Cables
5.1 List wire types, purpose of insulation and construction
5.2 Explain the American Wire Gauge (AWG) sizes of conductors
5.3 List common uses for copper cables in electrical and telecommunications applications
5.4 Explain differences between copper, coaxial and fiber optic cables
5.5 Explain the effects of proper and improper termination
5.6 Describe types and testing of splices
6.0 Electronic Components
6.1 Identify common electronic symbols of components and connection points
6.2 Identify types of switches and use in circuits
6.3 Describe fuses and circuit breakers
6.4 Explain where passive components are used in circuits
6.5 Identify resistor values by color code and numerical markings
6.6 Identify capacitor types, ratings and use in circuits
6.7 Identify inductive components, core materials and how coil diameter and wire size affect values
6.8 Identify common types of transformers and explain step-up/step-down in relation to turns ratio

7.0 Semiconductors
7.1 Explain P-N junction theory
7.2 Describe types of diodes
7.3 Explain Zener diode ratings; describe their usage in regulator circuits
7.4 Identify PNP and NPN transistors as to type and usage
7.5 Describe FET, MOSFET and CMOS types of components
7.6 Identify other semiconductors and symbols and explain their uses
7.7 Compare thyristors with other semiconductors
7.8 Identify diacs, triacs and SCRs and explain their operation
7.9 Identify common types of Integrated Circuit packages and chip cases

8.0 Power Supplies
8.1 Describe types of batteries and common usage including primary, secondary and rechargeable cells
8.2 Describe how to safely work on and around power supplies
8.3 Describe the differences between half wave and full wave power supply types
8.4 Identify components that determine output voltage and power
8.5 Explain the need for power supply filtering, describe hum, and identify common filter types
8.6 Explain the reasons for regulation in an electronic power supply
8.7 Explain why and where fuses and circuit breakers are located in protection circuits

9.0 Amplifiers and Analog Circuits
9.1 List common amplifier devices
9.2 List common amplifier configurations
9.3 Describe the purpose of components in an amplifier circuit
9.4 List the usages and classes of amplifiers
9.5 Describe decibel (dB) measurements, voltage and power gain
9.6 Explain frequency response of an amplifier circuit and why it is important
9.7 Explain the uses of operational amplifiers and how they differ from discrete amplifiers
9.8 Identify causes of distortion in amplifiers and list ways to reduce or eliminate it
9.9 List types of feedback
9.10 Describe types of oscillator circuits

10.0 Interfacing of Electronics Products
10.1 List signal levels in electronics products
10.2 List anticipated signal or voltage levels for output circuits in audio and video equipment
10.3 Explain the importance of impedance matching and list causes of mismatches
10.4 Explain common types of connectors
10.5 Explain grounding methods
10.6 Describe power transfer between circuits, components used and problems of mismatch

11.0 Digital Concepts and Circuitry
11.1 Describe the use of binary numbers and math, converting between binary and decimal
11.2 Identify symbol and function of digital logic gates: (AND, OR, NOT, NAND, NOR, XOR and XNOR)
11.3 Explain truth tables for basic gates
11.4 Explain Boolean equations from a truth table for combinational logic circuit
   11.4.1 Simplify Boolean equations using Boolean Algebra or K-map
11.5 Simplify combinational logic circuits to the fewest number of chips using NAND or NOR gates
11.6 Explain the purpose of a latch and list common flip-flops
11.7 Explain the purpose of clocks in sequential circuits
11.8 List types and functions of shift registers
11.9 Explain how counters and timers operate

12.0 Computer Electronics
12.1 Describe the major components of a computer
12.2 Describe how the computer block diagram and flow charts are utilized
12.3 Explain Operating System functions and common types
12.4 Explain the function of a bus and how it connects the CPU, peripherals, and/or memory devices
12.5 Describe different types of computer memory and how storage is accomplished
12.6 List various types of peripherals, USB and other connector usage
12.7 Describe how microprocessors function and identify internal sections

13.0 Computer Applications
13.1 Explain basic computer operation
13.2 List ways to backup data and the importance of daily back-ups
13.3 Explain the causes of line surges and viruses and protection procedures against each
13.4 Explain major components and use of the Internet, browsers and IP addressing
13.5 List commonly used programming languages
13.6 List commonly used software application programs

14.0 Audio and Video Systems
14.1 Explain major components of common entertainment, function and security products
14.2 Describe microphone types, construction and usage
14.3 Explain speaker construction, usage and precautions
14.4 List the types of cables and connectors used in audio and video applications
14.5 Describe distorted sound and electronic/acoustical causes of distortion
14.6 Explain how signals may conflict and the indications the conflict may produce, including interference and static
14.7 Explain how to isolate problems between discrete equipment

15.0 Optical Electronics
15.1 Describe symbols for photo resistors, photodiodes and phototransistors
15.2 List materials that make up optical devices
15.3 List common display devices and describe how numbers and letters are activated
15.4 Explain where and how LCD displays are used
15.5 Describe how LED devices function
15.6 List applications of opto-isolators
15.7 Describe uses for light-activated controls and photosensitive devices
15.8 Explain where charge-coupled devices (CCD) are found
15.9 List products where lasers are used

16.0 Telecommunications Basics
16.1 Describe major types of communications: landline, wireless and two-way
16.2 Explain half duplex and full duplex communications
16.3 Describe copper and fiber telephone local loop circuits
16.4 Explain the common connectors, plugs and jacks used in communications
16.5 List fiber optics types
16.6 List common RF (Radio Frequency) bands
16.7 Explain types and frequencies used in cellular communications
16.8 Describe common wireless schema, such as WiFi, Bluetooth, and Zigbee

17.0 Industrial and Manufacturing Automation
17.1 Identify types of DC motors
17.2 Describe the common uses of AC motors
17.3 Identify types of alternator and generator power sources
17.4 Describe use and types of sensors
17.5 Explain the use of ladder logic and control devices
17.6 Explain how microcontrollers and PLCs function
17.7 Describe the use and programming of major types of control panels
18.0 Test Equipment and Measurements
18.1 Describe how a Digital Multimeter (DMM) and related meters operate
18.2 Identify meter protection, safety and usage
18.3 Explain care of equipment and test leads
18.4 List the purposes and types of signal generators
18.5 Describe meter loading and precautions observed
18.6 List the uses and precautions for logic tracer test probes
18.7 Explain how logic pulsers are used
18.8 Describe oscilloscope usage and explain the purposes of front panel controls

19.0 Soldering - Desoldering Tools
19.1 Describe soldering safety
19.2 Explain hazards of solder fumes and solder spatter
19.3 Explain solder flux usage and describe types
19.4 List types of solder and reasons for choosing each
19.5 Identify cold solder joints and explain causes
19.6 Describe the differences between good and bad mechanical and electrical solder connections
19.7 Describe various types of desoldering equipment and how it is used
19.8 Describe how to use of braid-wick solder removers

20.0 Troubleshooting and Repair Procedures
20.1 Explain the order of the troubleshooting process and techniques to find problems
20.2 Describe how to locate/cross reference parts and products in catalogs and online
   20.2.1 Explain how to safely download service and technical information
20.3 Explain the purposes and requirements for proper documentation
20.4 Explain how block diagrams are used for troubleshooting and maintenance of electronics products
20.5 Explain the differences between wiring prints, circuit board views, schematics and block diagrams
20.6 Describe the purpose and use of test points including their likely placement on schematics
20.7 Explain how schematics are used to locate component and wiring failures in electronics products
20.8 Explain the methods of using flow diagrams/charts

End of Basic Student Electronics Competencies Listing
(with 20 major Categories, 160 Items)

Find An ETA Test Site:  http://www.eta-i.org/test_sites.html

Suggested additional study texts and resources:
The Associate CET Study Guide, 6E; ETA International; ISBN 1-891749-07-2; 2012; Available through ETA at 800-288-3824 or www.eta-i.org; $60
EM Study Guide series; Karl Eilers; download through ETA at 800-288-3824 or www.eta-i.org
Electricity & Electronics, 10E; Gerrish, Dugger & Roberts; ISBN 978-159070-883-5; Goodheart-Wilcox; 2008
Review MasteringElectronicsDesign.com website; RMS material; Adrian S. Nastase; 2013

Check online for NEETS module content: www.tpub.com/neets/index.htm

ETA certification programs are accredited through the ICAC, complying with the ISO/IEC 17024 standard.